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International Co-operation

Already, an informal meeting of foundrymen has been held during the course of the recent Jubilee Congress of the American Foundrymen's Association. There, a decision was taken to call together the delegates from a limited number of countries at a meeting to be held in Paris in October. Reviewing the work done between 1926 and 1939, the International Committee of Foundry Technical Organisations has ensured a continuous supply of exchange Papers between the participating nations. It organised a series of annual congresses, some of which were valuable, but one at least was little more than a pleasurable social gathering. A rota of foundry exhibitions was established—a feature which introduced commercial considerations and not always in the best interests of pure technology. At the side of this body were committees dealing with aspects of testing methods, and an international dictionary. Neither made noteworthy progress, but some good was forthcoming. The worst feature was the entry of politics—the first case being at Prague when the Nazis utilised the opening ceremony to assail their hosts. Again, the general atmosphere of the Düsseldorf conference was anything but cordial.

To bring about more cordial conditions in the future, it has occurred to us that consideration might be given to a system based on the following lines. All the premier associations hold an annual meeting, and to it there would come one other country in a rota to be established. This visit would be returned the following year. This would lessen the strain on the resources of the various associations, and enable more individual hospitality to be given. Moreover, it would prevent any delegates feeling that they were being neglected—a not unknown factor in the past. We certainly counsel the continuation of international technical activities, but this work should be undertaken by specially delegated individuals. Such delegates should report back to their national associations, and a time limit should be imposed for at least interim or majority and minority reports.

As for exhibitions, it is truthful to state that in the majority of cases they have been devoted to foundry supplies and equipment rather than to the products of the casting industry. Thus, it would seem logical for the equipment manufacturers to arrange an international rota of " foundry " exhibitions. We are well aware that we have indulged in over-simplification, but as we were not wholly satisfied with the pre-war set-up, we believe the time is opportune to redraft this organisation with the dual object of eliminating potential friction, and divorcing technology from business. To recapitulate, our suggestion is the re-establishment of the International Committee; the creation of a few auxiliary committees; the holding of two-nation conferences, and the divorce of exhibitions from these functions.

FE-S-C EQUILIBRIUM SYSTEM

A Paper by A. Norro and S. Lundquist on the Fe-S-C equilibrium system is published in " Jernkontorets Annaler," No. 3, Vol. 130, of 1946. The authors have investigated the mutual solubility in the liquid state of two phases, one rich in iron, the other rich in sulphur, and both saturated with carbon, for the temperatures between 1,300 to 2,000 deg. C. The solubility curve indicates that the temperature of complete miscibility was found to be 1,970 deg. C. at 9.5 per cent. of sulphur.

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COAL TO FUEL OIL CONVERSION

In a written answer to a parliamentary question, the Chancellor of the Exchequer stated that after consultation with the Minister of Fuel and Power he had decided to propose in next year's Finance Bill that the import duty of 1d. per gallon should be removed from heavy fuel oil and gas oil. In the meantime, from October 1, 1946, until the date when the import duty is removed, a subsidy of £1 per ton would be paid to consumers in this country of such oils, whether imported or home produced. The procedure for paying this subsidy and the precise grades of oil to which it will apply would soon be announced. The Chancellor added that these arrangements would afford an appreciable relief against the higher operating costs of oil-burning plant as compared with coal-burning plant, and he hoped they would result in conversions from coal to oil to the maximum extent possible.

Following the announcement the Ministry of Fuel and Power state that steps are being taken to encourage conversion of plant temporarily from coal burning to oil-fuel burning where it is clear that this may be done with advantage to relieve the present and prospective pressure on coal supplies.

Every assistance will be given to industrialists desiring to make the change and arrangements have been made for ordering in bulk the necessary equipment and oil-burning appliances so that the change, where applicable, may be made as speedily as possible.

Regional officers of the Ministry of Fuel and Power are now consulting industrial undertakings where plant conditions are suitable for conversions to oil from the point of view of helping the coal position as much as possible next winter. In making this review of possible conversions, special attention has been paid to continuous process industries. Included in the review are those cases where conversions could be carried out quickly, and, in addition, cases where new plant and equipment would be required, but where conversion would nevertheless be desirable in order to help the difficult coal position. Discussions are taking place with the gas and electricity industries and the railway companies.

Direct applications from consumers for conversion to oil-firing are being authorised, though, with a few exceptions, the quantity of oil involved in each case is relatively small. The Ministry is now prepared to authorise the use of oil in stand-by plants provided heavy oil is used and the plants are brought into continuous use; it is not practical, owing to distribution difficulties, for oil to be supplied to these plants for intermittent use.

[We have italicised one paragraph because most furnaces need redesigning when changing over from one type of fuel to another.—EDITOR.]

THE MINISTRY OF SUPPLY, through the Director of Contracts, Great Westminster House, Horseferry Road, London, S.W.1, are selling about 1,400 pairs of moulding boxes dispersed all over the country. Tenders have to reach the Director by 10 a.m. on August 16. The reference number is 166,001.

GERMAN TECHNICAL REPORTS

Additional reports submitted by teams of industrial experts, who have visited Germany under the auspices of the Combined Intelligence Objectives Sub-committee, the British Intelligence Objectives Sub-committee, and the Field Information Agency, Technical, for the collection of scientific and technical intelligence from German industry, are now available for publication.

These reports are distributed to the chief public libraries, and institutions concerned. Copies are also on sale, and may be ordered from H.M. Stationery Office at:—York House, Kingsway, London, W.C.2; 13a, Castle Street, Edinburgh, 2; 39/41, King Street, Manchester, 2; 1, St. Andrew's Crescent, Cardiff; and 80, Chichester Street, Belfast. The post-free price is given between brackets.

C.I.O.S. 499—German piston manufacture (11s. 3d.). B.I.O.S. 588—German domestic gas appliance industry (4s. 2d.). B.I.O.S. 465—High temperature refractories and ceramics (4s. 8d.). B.I.O.S. 505—Light alloy manufacture at Aluminiumwerke Göttingen G.m.b.H. Göttingen (1s. 1d.). F.I.A.T. 602—Aluminium pistons for automobile and aircraft engines (7d.).

CREEP TESTS ON NOTCHED BARS

Creep tests usually cause a fracture in a test-piece corresponding to either a ductile or a brittle material. The type of fracture occurring at the lower stress for a given temperature determines the suitability of a steel for a specific constructional purpose. Normally, creep specimens receive a uni-dimensional stress, but a three-dimensional stress of the same order would accelerate failure. For this reason, C. SCHAUB, of Stockholm, has investigated tensile tests for prolonged periods on notched or grooved bars, and his experiments, carried out during the war, are described in a Paper published in "Jernkontorets Annaler," Vol. 130, No. 1, 1946. The author advocates the adoption of a durability test on notched bars, in addition to normal tensile or creep tests to discover the behaviour of a steel to be used for constructions exposed to high mechanical stress at elevated temperatures. In such a test, a stable steel should not show any tendency to embrittlement, nor be susceptible to crack formation in the root of the notch similar to "stress corrosion."

RESTORATION OF BRITISH PROPERTY

Claims for the restoration to British owners of the control of their property in Yugoslavia will be dealt with by the Mixed Commission which has been set up in Belgrade. A register of British property will be kept in the Trading with the Enemy Department, 24, Kingsway, London, W.C.2, to which address application should be made for the appropriate forms.

To the same address should be sent claims for compensation for property belonging to British persons which has been affected by the nationalisation schemes of Poland and Czechoslovakia, as the British Government are now willing to look into these matters.

THE PRODUCTION OF "GRAND SLAM" BOMB CASTINGS*

Exchange Paper to the American Foundrymen's Association.

By BASIL GRAY, B.A., Cantab.‡

During the war the output of the steelfoundries of Great Britain was more than doubled, by the additional output from new Government sponsored factories managed by existing firms, converted ironfoundries, and, to a small extent, by extensions. These projects, the castings produced as a result of them, and the methods employed, could well supply appropriate subjects not merely for one but for several exchange papers. Some of the mass-production foundries designed to produce bomb cases and tank track links, for instance, were so fully mechanised that castings up to 500 lb. in weight were produced with a labour force comprised, in some cases, of 80 per cent. women.

There were many developments in tank armour castings in which the leading producers co-operated to a degree previously unknown, with excellent results, as shown by the improvement in quality and technique that followed. The co-operation, started in this way, has engendered a new spirit in the steel castings industry of Great Britain, and to-day the British Steel Foundry Technical Association which, itself, would form the subject of an interesting talk, is a live organisation in which members of some 80 per cent. of the foundries take an active part with the fullest interchange of ideas and information.

The production of the "Grand Slam" and "Tallboy" bombs were chosen as a subject, not because they supplied front page news in the popular Press a year ago, but because the method to be described included a revised version of an old and little-known technique which, in a limited field at least, has proved of great value.

The production of these bombs has been illustrated in the American Press with a very creditable description largely deduced from photographs and brief technical data, but the reasons for adopting such an unusual method for constructing the core must, nevertheless, have been rather puzzling to many readers, and a detailed description may be of interest.

Moulding with a Strickle

The striking up of a mould with a strickle is almost as old as the art of founding itself, but the striking up of cores on a core barrel, though also an old practice, is less well known. Iron and non-ferrous foundries employ the method in a simple form for the manufactude of pipes and tubes, but for steel castings its use is confined to a few foundries that specialise in the production of large hydraulic cylinders and similar work.

Nearly 100 years ago cast steel church bells† were made in some quantity by the Author's firm, using a similar process. The mould (Fig. 2) was formed on a plate with a strickle post fixed to it and a bell-shaped cast-iron piece (*C*) with many perforations to allow the escape of gases and moisture, was threaded over it. The loam (*D*) was applied, struck up to shape with a strickle board and dried. A clay mixture (*E*) came next, which was strickled to the shape of the outside of the bell and also dried. The cope (*F*) was then rammed up by ordinary methods using the clay as the pattern or "thickness," as it used to be called. When the cope had been lifted the clay "thickness" was broken away and the mould was completed.

The earlier samples of the 6-ton "Tallboy" were made by jobbing methods, using a barrel core. They had a number of successes, such as the perforation of the U-boat pens at l'Orient and the collapse of the entrances to an underground garage for the V.1 rocket planes.

Foundry Conditions

The demand for maximum output which followed came at a time when all the mechanised foundry and the heavy moulding machines were fully occupied on tank castings and similar important work, but when the heavy moulding pits and their crews were comparatively slack owing to the cessation of the demand for heavy war production plant. In the same way, steel was not available in the convenient amounts obtained from the electric furnace and only the 40- or 60-ton acid open-hearth furnaces could supply the quantity necessary.

The Grand Slam required 10 tons of steel and the Tallboy six tons, so that the foundry had to assemble eight Tallboys moulds or four Grand Slam at a time to make up a cast. One pit, enlarged to hold twelve

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* A Paper read before the annual conference of the Institute of British Foundrymen.

† The following brief notes on the steel bell industry may be of interest to the historically minded :—"Bells were made up to eight tons in weight as will be seen from the price list. Up to 500 pots of crucible steel of 68 lb. each were required for such a casting which must have taken considerable organisation. An old servant of the company told the Author many years ago that men of every trade from all over the works took a hand and, working in pairs, carried a pot to the mould, poured it in and then returned to their own jobs. Meyer of Bochum, Germany, under whose licence the bells were made, was probably the first man to make a steel casting of any size. He was the founder of the firm that became the 'Bochumer Verein' which, until V-E Day, owned the largest and best heavy foundry in Germany. It is stated in Berdrow's 'Life of Alfred Krupp,' that when he saw the bells at the Paris exhibition of 1851 he pronounced publicly that they could not be steel but were ordinary iron. The Author's firm had a large trade with the U.S.A. in those days and it is on record that one of the bells fell from its tower during the great fire at San Francisco in 1906 but was recovered undamaged and used again."

‡ English Steel Corporation, Limited, Sheffield.

"Grand Slam" Bomb Castings

boxes of Tallboys and a smaller one to hold four were available, but these pits could only be served by one crane.

The cycle for melting was 14 hours from tap to tap, and it was essential for the foundry to be able to produce moulds sufficiently fast to take successive heats if the rate of production was to be maintained. The moulds could be removed from the pit after eight hours and knocked out after 24 hours, so that some 24 sets of boxes and tackle were required.

It was evident that the time taken to assemble the moulds with the one crane was going to be the bottleneck in production, and that everything possible must be done to speed up the process.

In the fifth year of war the installation of a special plant was out of the question, owing to the tremendous demands of D-Day on the engineering shops, and the

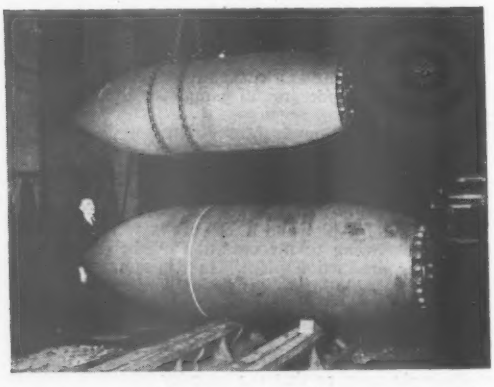

FIG. 1.—THE "TALLBOY" AND "GRAND SLAM" TYPES OF BOMBS.

methods of production now described were an improvisation designed to meet the special circumstances.

A high degree of accuracy was required, both in thickness of wall and in streamline form to ensure true flight. The indifferent timber available for the patterns was likely to distort, and the problem of obtaining the large numbers of machined and pinned boxes required for rapid and accurate closing seemed insuperable under the conditions prevailing. On the other hand, sufficient lathes were available to machine the outsides which were therefore given a machining allowance. One or two were cast to size and proved acceptable but the moulds took too long to close and more time was required for finishing in the dressing shop where the labour force was short.

Moulding equipment followed ordinary practice with patterns in sections on plates and ramming was by pneumatic hammer. Five boxes of special design, as shown in Fig. 3 were used for the Tallboy, whilst the heavier bomb, of which fewer were needed, was made in a similar way, but in the foundry's standard shallow 6-ft. by 4-ft. boxes clamped together in suitable numbers to bring the joints to the right level.

Fig. 4 shows the bottom part as moulded, with a heavy chill, separated from the top of the pattern by a thin core. The chill serves to locate the core and chills the heavy nose end of the bomb. When ramming up is completed the sand is strickled off and the bottom plate bolted on. The other boxes shown call for little explanation, but a point worth noting is the fireclay pipe down-runner to the side head feeding the bottom. This type of head with a tangential runner is known in England as a "Whirlgate," and has been much used in recent years. The down runner and a similar dummy runner on the other side of the pattern were used with the help of a close-fitting rod to locate the boxes in closing. The method proved very successful and presents advantages over the more usual

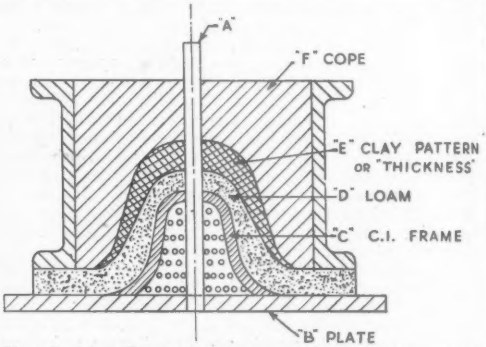

FIG. 2.—AN EARLY EXAMPLE OF LOAM MOULDING AS APPLIED TO BELL-FOUNDING.

ball and socket device often employed in such circumstances. The boxes were dried with portable coke-fired stoves as seen in Fig. 5.

Structure of the Main Body Core

Normal methods of core construction were considered but were not adopted because of the difficulty of obtaining satisfactory wood, and because the slight adjustments that might be required to the dimensions would be more difficult. A stronger argument still was that the cores used in the earlier bombs had proved very successful and few foundrymen are in a hurry to abandon a success in search of problematical economies. As can be seen from the drawing (Fig. 6) and Fig. 7, the main body core consists of refractory material built round a wire cage or skeleton mounted on a core barrel.

The more common practice in striking up similar shaped cores is to build up the rough shape of the

core by means of fire bricks, loam or "compo" bricks on a steel barrel wound with wood rope; this rough, brick-built shape being covered with refractory material and strickled off to shape. The time required for building up a core in this manner is considerable and the result is of rather solid construction allowing less chance of contraction and consequent risk of "pulls" even though the barrel is pulled out as soon as the steel has set sufficiently.

It was considered that with a hollow cage the core would be quicker to make and the risk of "hot pulls" would be eliminated. Its construction could be broken down into simple operations requiring little skill, thus releasing the expert moulders for the finishing work. In practice, it has been found that of the many hundreds of these bombs which have now been made not one has been torn by contraction. Furthermore, the skin of the castings inside has been exceptionally good and one can only conclude that this has been brought about by the absence of severe pressure from a contraction between the skin of the casting and the moulding material.

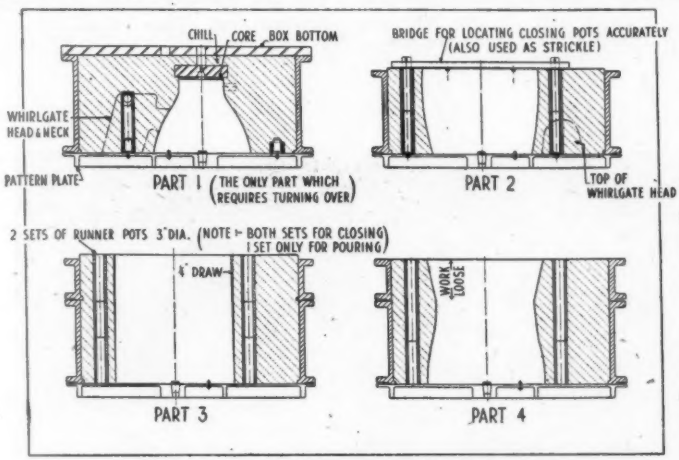
CHILL
CORE BOX BOTTOM
WHIRLGATE HEAD & NECK
PATTERN PLATE
PART 1 (THE ONLY PART WHICH REQUIRES TURNING OVER)
BRIDGE FOR LOCATING CLOSING POTS ACCURATELY (ALSO USED AS STRICKLE)
PART 2
TOP OF WHIRLGATE HEAD
2 SETS OF RUNNER POTS 3"DIA. (NOTE - BOTH SETS FOR CLOSING 1 SET ONLY FOR POURING)
¼" DRAW
PART 3
WORK
LOOSE
PART 4

FIG. 3.—BOX PARTS USED FOR BOMB CASTINGS.

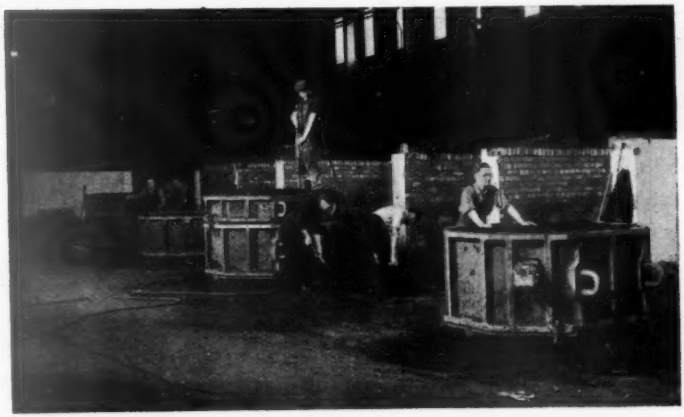

FIG. 4.—MOULDING STATIONS SHOWING BOTTOM HALF BOXES RAMMED-UP.

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Parts Forming the Main Body Core

Core Barrel: Both the Tallboy and the Grand Slam are manufactured in a similar way, the only difference being the size of the parts used. As a consequence the Author in giving a description of the tackle will give the sizes for the Tallboy only. The backbone of the core is a cast steel core barrel 12 ft. 6 in. long, 15 in. outside dia., with walls 1½ in. thick. As can be seen from Fig. 6 the nose end (A) is closed, and the tail end has a bridging star (B) fitted. Both the nose end and the star are drilled and tapped to take screwed trunnions. At intervals of approximately 9 in. pitch, 1½ in. dia., holes are bored or burnt in the barrel to form vents. This is done in order to allow any gases which form during casting to pass through and up the barrel to the atmosphere. At the tail end of the core barrel are two 4½ in. dia. holes (C). These holes are used for suspending the cores in a special rack whilst waiting to be put in the moulds, and also for pulling out the barrel after the bomb has been cast. The core rack can be seen in the photograph (D). At intervals along the barrel six V-grooves are machined in order to indicate the location of the grids (E), which are of "open-cast" iron about ¾ in. thick.

Assembly of the Cage: The core barrel described is supported on two stands by the trunnions, and the six cast-iron core grids are placed over the barrel and wedged into position over the marking grooves by two steel wedges. Through the holes in the grids, mild steel rods, ½ in. dia., are passed and secured into position by soft wood wedges. At the nose end of the core the cage is made solid by packing between

FIG. 5.—SHOWING THE PORTABLE HOT AIR DRYERS IN USE OVER THE MOULDS.

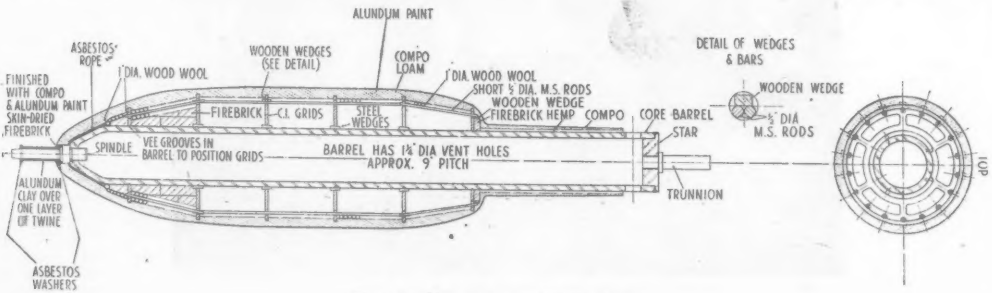

FIG. 6.—SECTION THROUGH CORE.

the grid and the barrel with firebrick. This is done in order to strengthen the structure to withstand the upward pressure of the steel during pouring, but is not really necessary as will be explained later. The grid at the nose end, as can be seen in Fig. 7, has

Making the Nose End Core: The nose end core is built up on a specially screwed pin which replaces the trunnion in the main barrel; the other end of the pin is tapered to fit into the chill plate of cast iron in the bottom of the mould. Both the trunnion and

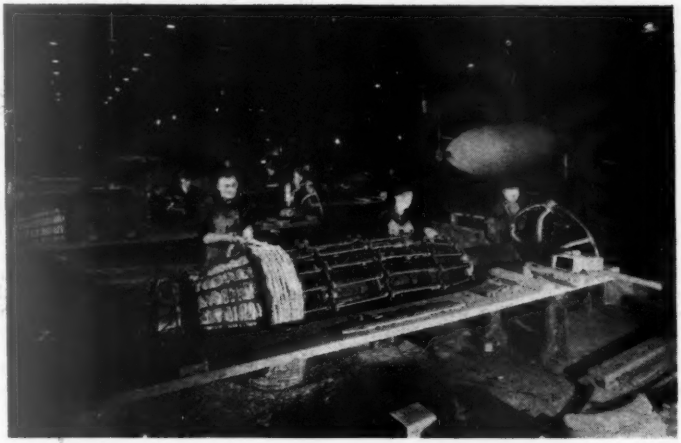

FIG. 7.—METHOD EMPLOYED FOR MAKING THE CORES.

½-in. diameter rods cast in. These are bent over the firebrick and wired down to give the desired shape. Over this steel and iron cage 1-in. dia. wood rope is wound. This is done by one operator turning the whole barrel by means of a handle, whilst another operator feeds on the rope. The rope has to be fed on carefully so that it forms a tight continuous skin.

Core Making: The coremakers now take over the assembly which is still on the pedestals or stands. Their first operation is to cover the whole of the structure with semi-stiff "compo" loam. When the structure has been thus covered, long lengths of reinforcing ¼-in. dia. rod are laid along the lengths of the barrel and pressed down into the loam. Wire, $\frac{1}{16}$ in. in dia., is then wound tightly round the barrel at 2 in. pitch holding the rods in position and making further reinforcement.

After drying for four hours at 400 deg. F. in special stoves the core is taken out and whilst still warm, a further layer of wet "compo" loam, ¼ in. thick, is added and roughly strickled to shape. Due to the heat already in the core this layer of loam dries fairly rapidly and the coremaker immediately applies a coating of chamotte (ground calcined fireclay), strickling to shape all the time. This is followed by a coating or alundum paint. The whole core is then placed back in the stove and dried for a further two hours. Between operations the strickle board is adjusted to give the thickness desired in each layer. The core is checked for size before and after drying, a profile template as well as calipers for diameter being used.

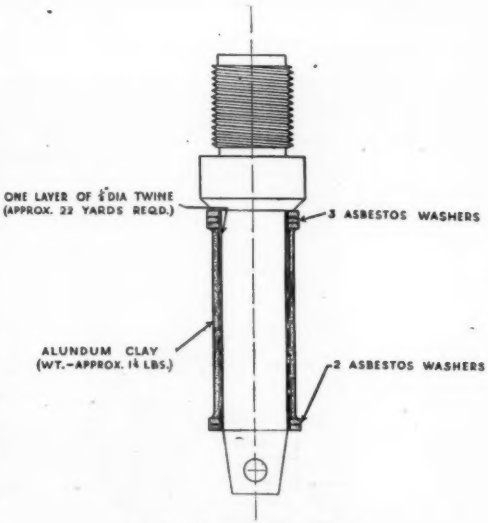

FIG. 8.—TYPE OF PIN USED.

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the chill plate are carefully machined as they form the locating point of the core.

The pin shown in Fig. 8 is mounted on a special strickling machine. One layer of ¼-in. dia. twine is wound on and a coating of alundum loam ¼ in. thick is strickled over the twine. An asbestos washer is fitted as shown in the diagram. The whole of the trunnion is then placed vertically in a stove and dried at 660 deg. F. for 2 hours.

The Production Department's idea of a cage to replace the old laborious method was accepted with approval by the experienced coremakers, but they were very careful to anchor the longitudinal rods firmly to the bottom by bending the ends into a hook. Sufficient attention had certainly not been given to this point in the original design. As production increased inexperienced moulders were brought into the work and this part was not so well done, with the result that the steel broke through a number of times owing to the core slipping up the barrel. To overcome this the core was filled in (at the nose end), although no trouble was experienced when the experts were on the job. These were the only occasions when the cores failed throughout the work.

Special Tackle Made to Assist Core Manufacture

Core Drying Stoves: Owing to the output of bombs required it was necessary to design and erect a battery of special core drying stoves, capable of quick loading and unloading. The design finally adopted, as shown in Fig. 9, consists of two trestles around which a brick wall is built. Over the top of the brick wall light asbestos-lined steel hoods are fitted, while running the length of the chamber is a brickbuilt flue with outlets at intervals for hot air. The hot air is introduced by means of fans coupled to portable coke-burning stoves. A plate on either side of the air inlets induces a circulation round the bomb and an exit through vents at the bottom of the outer wall.

The temperature is controlled by thermo-couples introduced at intervals along the stove. The cores are moved about during manufacture on the special lifting beam shown in Fig. 7.

Core Transport Bogies.—Owing to the geography of the shops it is necessary to transport the cores across two bays. In order to do this without damaging the core a special bogie was made from stock materials. The core is rested on the bogie trestles and the trestle at the nose end is pivoted allowing the core to be upended by means of an overhead crane whilst still on the bogie, thus avoiding damage to the body of the

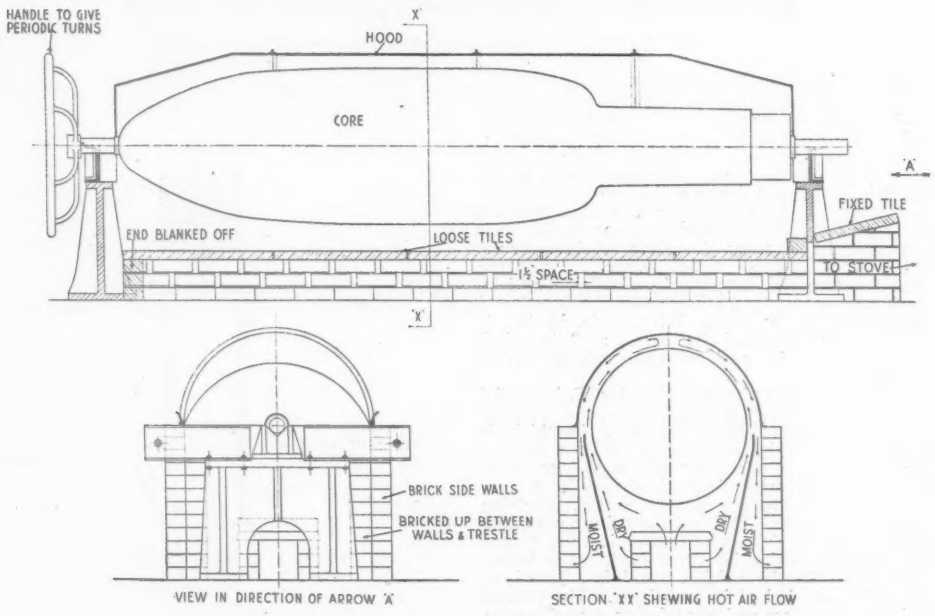

FIG. 9.—DIAGRAMMATIC SKETCH OF CORE DRIER FOR SPECIAL BOMBS.

core. The bogie is hauled by a locomotive to a carefully timed schedule and is also used for the transfer of moulding boxes.

Core Storage Rack.—Fig. 10 shows cores hanging on the storage rack. This serves not only to store the cores but also as a means of holding them while the temporary trunnion is replaced by the locating pin with its refractory covering. Otherwise, this would have to be done while the core was hanging in the crane which would take too long, as the joint has to be made up and dried with a blow lamp. The core can be taken from the rack and set in the mould in a very few minutes.

Assembling the Mould

The three bottom boxes are often assembled ready outside the pit to save time and in the picture there are two sets side by side, into one of which the core is being lowered. The lady standing on the edge of the mould with a 15-ft. drop at her toes is holding the wooden wedges with which the mould is temporarily stayed. A hole is left in the bottom mould through which one moulder can guide the core-centring pin into its socket in the chill. A core is used to fill the hole when core setting is completed (Fig. 11.)

The remaining boxes are lowered into position and the whole clamped up in the usual way. The core is held down by the special bar which in turn is fastened to the box by the rings and wedges, as seen in the photograph. The trunnion projecting through the holding down bar can be adjusted sideways by wedges to centre the core in the mould, and the adjustment of the holding down pressure is also obtained by a wedge lightly driven between the underside of the bar and the barrel. Care has to be taken in this operation, as the wedges sometimes come loose, if left for an hour

FIG. 10.—CORE STORAGE RACK.

FIG. 11.—SHOWS A GENERAL VIEW OF THE CASTING PIT.

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or so, owing to the contraction of the barrel when cooling down from the drying operation.

The arrangements described achieved their object in minimising the time taken to assemble a mould to the extent that on several occasions the gang closed a full cast of eight moulds, from start to finish, in under three hours, using only the one crane.

Casting

The steel in the smaller bomb is run with a 1¼-in. dia. nozzle in about 1 min. 40 secs., when the ladle is full, and care is taken to ignite the gases from the core as soon as they start to come out from the barrel. It was these gases that were the principal anxiety, as a hollow core had not been tried before, and it was not known whether there would be a danger of explosions.

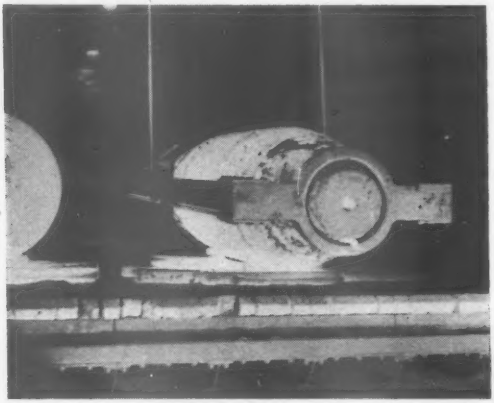


FIG. 12.—SPECIAL TACKLE FOR OIL DIPPING.

In practice no explosion at all occurred unless the steel broke in as in the few cases mentioned above. Even then there was no "blow" if pouring was stopped at the first indication of trouble, and at no time was the explosion dangerous or even very alarming to those used to dealing with heavy steel castings. Half an hour after casting, the core barrel is pulled out with the overhead crane, the cast-iron grids fastened to it are broken in the process and the core is thus most thoroughly eased. The full boxes seen on the right of Fig. 11 are stripped after 24 hours. The heads are burnt off hot and the castings charged into a furnace for annealing at 1,000 deg. C.

Dressing

The roughing off operation which follows is laborious with a solid core, but with the core construction used it is much easier. The remains of the grids are hooked with a chain and pulled out, which breaks up the core still further and makes it an easy matter to clean off the greater part of the remaining sand with pneumatic chisels and long bars.

Steel Used

A chrome-molybdenum steel, known as "Hykro," was used, and conformed to the following analysis range: C, 0.30 to 0.34; Si, 0.35 max.; Mn, 0.50 to 0.70; S and P, 0.030 max.; Ni, 0.50 max.; Cr, 3.2 to 3.5; and Mo, 0.50 to 0.60 per cent.

FIG. 13.—SHOT BLASTING PLANT.

Heat Treatment

Final heat treatment consisted in air or oil hardening from 950 deg. C., and tempering at 600 to 630 deg. C., according to specifications that were amended from time to time.

A tensile and Izod impact test piece, cut radially from a test ring removed at the base of the top head, was prepared from representative castings, but each individual casting was Brinelled in six positions taken spirally from the top to bottom side.

Typical mechanical tests obtained are detailed in Table I.

The special tool for oil dipping is shown in Fig. 13. It consists of a frame with a fixed ring at one end which is threaded over the nose while the casting is on the furnace car. Another ring sliding on the frame is then pushed over the large end with bars and the casting can then be lifted by the overhead crane to a vertical position and dipped immediately in the oil.

Finishing

The inside is shot-blasted in what was a rotating table Wheelabrator machine, altered to suit the work. The Wheelabrator on the roof was removed and the

FIG. 14.—VIEW IN THE MACHINE SHOP.

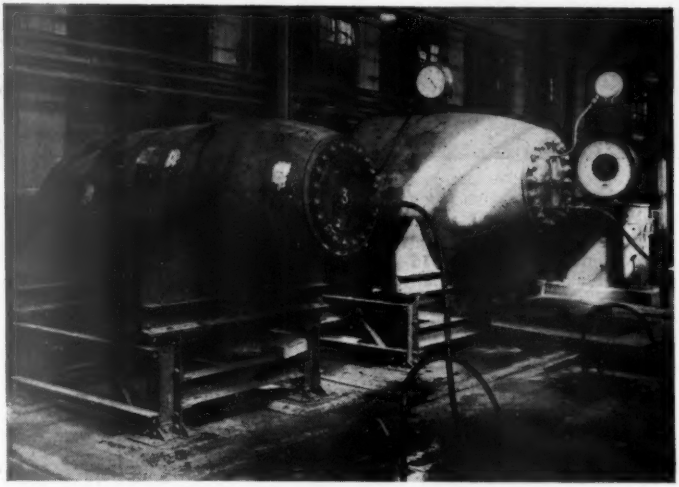


FIG. 15.—SET-UP FOR HYDRAULIC TESTING.

"Grand Slam" Bomb Castings

bomb slung in its place from a beam. The bomb is rotated by fibre-covered friction wheels bearing on its outside and driven through V-belts by the motor that previously rotated the table. A long blast pipe with nozzle at right angles is fed up the bomb by means of the winch and wire rope which the man is seen operating in the picture. The success of the core in giving a clean skin results in little further work being required on the inside after shot blasting, except at the nose end which cannot be reached by the shot. A very smooth surface is required to avoid danger while filling with explosive, but, in spite of that, welding was hardly ever necessary.

this somewhat unusual casting, but it should be mentioned that it has also been made successfully by more normal methods in another foundry in Scotland and also in a foundry in the U.S.A. It has also been made in the U.S.A. from a welded tube to which castings were welded to form the nose and base. Nevertheless, there is no doubt that if the job had to be started again little alteration in method would be made in the foundry whose work is described.

A Sandslinger with a pattern draw machine would improve the moulding and some improvement might be made in the construction of the cage, for the core. The cost of the core may be a little high, but that is more than offset by savings elsewhere, particularly in the dressing shop.

A special acknowledgment is accorded to Mr. C. A. Chaytor, foundry manager; Mr. Whitehouse and Mr. Shepherd, foundry engineers, who were directly responsible for actual production and design of tools, for their assistance in preparing this Paper. The Author is indebted to the R.A.F. and directors of the English Steel Corporation, Limited for permission to publish the Paper.

FIG. 16.—BOMB IN FLIGHT.

This is not the place to describe the machining operations, but a view in the machine shop is given in Fig. 15 which may be of interest, while Fig. 16 shows the bomb as carried in the aircraft with its tail about 22 ft. long.

This Paper has described one method of making

TABLE I.—*Mechanical Properties of Steel Used for Heavy Bomb Manufacture.*

		Y.P. Tons per sq. in.	M.S. Tons per sq. in.	EL. Per cent.	RA. Per cent.	Izod.		
Normalised	920 deg. C.							
Tempered	630 deg. C.	33.6	47.0	20.5	49	30	25	28
Oil hardened ..	920 deg. C.							
Tempered	630 deg. C.	36.4	47.6	20.0	46	55	52	36
Oil hardened ..	920 deg. C.							
Tempered	600 deg. C.	46.6	59.8	19.0	44	19	18	18

GRAIN SIZE IN MAGNESIUM CASTINGS

Writing in "Modern Metals" under the title "Economics in Magnesium Foundry Practice," Mr. C. H. Mahoney and Mr. P. E. Le Grand describe a series of experiments they have carried out with the object of stabilising grain size by inoculation.

In a typical carbon inoculated melt, and in order to show the normal coarsening with increasing temperature before inoculation, the treatment was not made until the metal had reached a temperature of 799 deg. C. The resulting grain refinement is characterised by aparent greater stability, and remains essentially the same size throughout the three casting temperatures of 799, 749, and 699 deg. C. Even at 649 deg. C. there has been no change of importance. Heating to a higher casting temperature will not cause a loss of refinement and inoculation may satisfactorily be made if desired at any temperature after the metal has become molten. The tendency for grain size stabilisation is quite marked and carries over to subsequent remelting although the remelted metal will not have as fine grain as it had before being allowed to freeze. The inoculation may be accomplished by any of a number of methods and is sufficiently simple that different shops can be expected to develop preference for procedures particularly suited to their equipment and melting methods. The authors have tended to prefer treating by bubbling propane gas through the melt, but have had equally good results by stirring either lampblack or finely divided graphite into the metal. This preference for propane over other hydrocarbon gases is based entirely on the purity of this commercial gas and its comparative freedom from tendencies to contaminate the melt with oxides, nitrides, etc. It has also been more convenient under their own shop conditions to use a gas. However, and to the contrary, the only two shops that to their knowledge have used the inoculation method on a continual production basis, used powdered graphite and lampblack respectively. Extensive investigational work has also been done on using powdered aluminium carbide as well as a mixture of chlorine gas and carbon tetrachloride vapour. Finely divided pitch coke and also calcined petroleum coke have given excellent results.

Pointers from Practice

The principal problems with the process seem to be associated with affecting good distribution of the carbon and with bringing the carbon into intimate contact with the molten alloy. The effect can be completely nullified or prevented by having excessive amounts of liquid flux in the melt or by allowing the gas to bubble through a flux accumulation in the pot bottom before rising through the metal. Similar failure in results is evident if the powdered carbon addition is allowed to become melted and entrapped by liquid flux. Experience has indicated that the bubbling of chlorine gas through the melt either during the inoculation treatment or afterwards tends to reduce the effect of inoculation.

Recognising that the proof of practical value of such a development lies in its adaptability to production use, in early 1944 the authors offered the process to the Century Metalcraft Manufacturing Corporation of Los Angeles, which was the first foundry to use the process in America. The following letter of May 12, 1945, from their chief metallurgist, Mr. C. H. Adams, is of interest.

> Our experimental work here on grain refining in magnesium by carbon was begun late in May, 1944. By the middle of June that year we had converted the large castings to the carbon grain refining instead of superheating. Two weeks later we stopped superheating the large holding furnaces from which we pour small castings. We still must superheat to get consistently fine grain if we use 50 per cent. or more of non-grain refined ingot. However, our recycle of gates and risers, etc., is such that we seldom use more than 50 per cent. primary ingot.
>
> The average grain size in our large castings sections is from four to six thousandths inch, with maximum of about eight thousandths inch, occasionally as high as six or seven thousandths inch.
>
> As you know our experience has been one that melting and carbon grain refining operations on primary coarse grained material is not sufficient to give satisfactory casting, but that recycling with or without additional carbon refining does produce good castings, all this, of course, without superheating above 789 deg. C. Of course, we, like you, have a great deal more success by this method in small pots than larger ones, due to proper contact and distribution.

The above quoted shop tried both carbon black and graphite in their early efforts and eventually expressed a preference for graphite on the counts of cleanliness in handling and increased ease of stirring in. Availability, however, forced them normally to use carbon black. In the authors' opinion their need for a 50 per cent. recycle of previously treated metal arose from their practice of adding the carbon during and just after the melt down in the presence of considerable quantities of melting flux. Their carbon addition was on the basis of 0.1 per cent. of the metal weight. This plant was devoted to the production of die castings, and one of the large castings referred to above was an engine base casting with sections ranging from ⅜ to 2½ in. in thickness on which their production rate requirement was in excess of 100 per day.

Superheating Eliminated

The process was also disclosed in the mid-year of 1944 to Light Metals, Limited, of Renfrew, Ontario, Canada, whose owner-manager had directed the Technical Service Department at Basic Magnesium, Incorporated at the time the grain size investigation had been started there. His report as of February, 1946, was that on receiving the information on the treatment he had immediately incorporated the process in their foundry and that no production metal had been superheated in their shop since the first tests. Their method consists simply of laying approximately 0.1 per cent.

(*Continued overleaf, column* 2.)

PETROLEUM DISTILLATION EXTRACTS FOR REPLACING LINSEED OIL IN CORE-BINDERS

In view of the increasing shortage of linseed oil, it is important that consideration should be given to the possibility of replacing its use in core-binders by aromatic extracts removed by solvents from the lubricating oil fraction of crude petroleum. These extracts are available in considerable quantities, and are of uniform composition.

The possibility of replacing part of the linseed oil used in core-making by these extracts has been the subject of an investigation at Sheffield University by Dr. Davies and Dr. Rees in collaboration with the Petroleum Board technical staff. The results of this investigation have been published in the Journal of the Iron and Steel Institute by the Steel Castings Research Committee, whose work is being continued, as it is taken over, by the Steel Castings Division of the British Iron and Steel Research Association.

As a result of these researches, the following conclusions have been reached. In sand mixes bonded with 2 per cent. linseed oil, up to 40 per cent. of the linseed oil can be replaced with any of the extracts examined, except one, without any falling off in tensile strength. The exception, that designated Group 1A (140), causes a gradual drop in tensile strength from 392 lb. per sq. in., the value for linseed alone, to 335 lb. per sq. in. at 40 per cent. replacement.

With all the extracts, a rapid decrease in tensile strength occurs when over 50 per cent. of the linseed oil is replaced by extract, and with over 60 per cent. replacement surface friability after drying develops. With up to 40 per cent. of extract in the oil, however, both strength and surface firmness are equal to those with linseed oil alone. The optimum drying treatment for A.F.A. test pieces bonded with the mixtures was found to be 2 hrs. at 200 deg. C. With up to 40 per cent. extract the milling conditions required are similar to those for mixes bonded with linseed oil alone, except in the case of a few of the most viscous extracts which need rather more milling. Extract Group 1 (72), however, which gave the best all-round properties, is of a consistency that makes it easy to handle. Premixing of the extract and linseed oil is not necessary, though doing so lessens slightly the time required to obtain a uniform mix.

Influence on Various Types of Bonds

For core compounds rich in starch up to 50 per cent. of the linseed oil can be replaced by extract, giving increased green compressive strength without materially altering dry compressive or tensile strengths. No surface friability results. For core compounds rich in dextrin up to 40 per cent. of the linseed oil can be replaced by extract, giving increased green compressive strength, but slightly lower dry compressive and tensile strengths. No surface friability results. For core compounds rich in molasses replacement of 50 per cent. of the linseed oil gives an increase in green compressive strength, but lowers dry compressive and tensile strengths. After drying, the surfaces show slight friability. For core compounds rich in sulphite lye replacement of 50 per cent. of the linseed oil reduces the dry compressive and tensile strengths.

The replacement of linseed oil by an extract/linseed oil mixture containing 40 to 45 per cent. extract does not alter the stripping qualities of sand mixes. Trials carried out in two steelfoundries confirmed these findings. In one of these foundries 40 per cent. of a commercial core oil was replaced by extract Group 2 (2239) with complete success. At another, 40 per cent. of the linseed oil in a commercial core compound was replaced by extract Group 1 (72) with completely satisfactory results. At another foundry where cores are normally skin-dried at 140 deg. C. for 1 hr., an increase in the number of rejects was reported following partial replacement of linseed oil by extract in the core mixture. Tests show that complete drying out is necessary to get optimum results with extract/linseed oil mixes, 2 hrs. at 200 deg. C. being sufficient for A.F.A. test-pieces.

Mr. W. B. Parkes, of the British Cast Iron Research Association, has drawn attention to some difficulties encountered in certain ironfoundries due to distortion in the green state of core assemblies when petroleum distillation extracts were constituents of the core oils. It is possible that these difficulties may be eliminated by the use of high-viscosity petroleum extracts admixed with linseed oil, and it is understood that triais in this direction are to be made.

Readers requiring further information should write to the Director, British Iron and Steel Research Association, 11, Park Lane, London, W.1, mentioning the FOUNDRY TRADE JOURNAL.

GRAIN SIZE IN MAGNESIUM CASTINGS

(*Continued from previous page.*)

by weight of lampblack on the relatively flux-free surface of the metal and stirring it in at a temperature in the range of 690 deg. C. At this low temperature little burning occurs at stir-in. The metal is raised to the temperature required for the casting operation and a few minutes are allowed to aid in settling before casting. This is a sandcasting foundry, and has established an enviable record for superior quality castings. It is of interest that records submitted on their production test-bar data show unusually high mechanical values.

THE NICKEL BULLETIN for June contains numerous abstracts, many of American origin, including a summary of reports on the adhesion of electro-deposits, nickel plating on aluminium and zinc-base die castings, foundry practice, standard test-bars for non-ferrous castings, bearing metals, magnetic materials and methods of improving the forming qualities of low-alloy steel. Copies of the "Bulletin" may be obtained from The Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1.

ARE METAL PRICES DANGEROUS?

By "ONLOOKER"

It was only at the beginning of July that sharp increases in the current quotations for copper, lead and zinc were announced, and no doubt all those who had been maintaining a long position, in the expectation of a rise, felt pleased, and perhaps a little relieved, that their period of waiting was over. These speculators certainly could not complain that profits were slow in accruing, for it was only three months earlier that an increase took place. True, something in the nature of a prologue was seen rather more than 12 months ago, when zinc and lead added about £5 to their "stature," but it was not until this year that the boost in metal values really started. It can, of course, be ascribed to the producers' bid for freedom when the war ended, and also, so far as the British Government is concerned, to a laudable decision to eschew the policy of subsidising the consumer at the expense of the taxpayer. In America, O.P.A. seems to be on its last legs in spite of the reimposition of ceiling prices for many products, but most people feel it will be rather surprising if there is much O.P.A. legislation remaining in a year's time.

American Influence

Following the news at the end of the half year that copper was up to £84, and zinc to £50, there was a brief halt in buying enthusiasm, the break being accentuated by the uncertainties connected with O.P.A. legislation in the U.S.A., and the holiday break here at the end of July. It is already obvious, however, that the bull market is not yet played out, for with 16 cents. f.a.s. port of shipment, up on the score board, enthusiasm has returned, and British buyers are disregarding (probably quite rightly) the fact that a ceiling of 14⅜ cents has been reimposed on copper in the domestic market of the United States.

If the Ministry of Supply stick to their plan to pass on to the users the increased prices they have to pay for imports of copper—and there is every reason to suppose that they will—then we must look forward to a sterling quotation above £90 before the end of the year. In view of the dates on which the adjustments have been made so far this year, there is some justification for the belief that the authorities take stock of their situation quarter by quarter, and that being so we may look for another change at the end of September. Similarly, some further advance is expected in lead and zinc, for it is generally anticipated that these two will be "ceiled" at 9½ cents, and it is doubtful whether the British Government will succeed in buying below that level f.a.s. shipping port. As for tin, the writers and commentators on the non-ferrous metal situation have grown tired of prophesying an increase of anything up to £75 per ton, for it is quite certain that at £300 this metal is much under-priced. The delay seems to be due to the protracted negotiations with the somewhat widespread interests involved.

In spite of the bull market there is a certain amount of uneasiness discernible at current levels, for buyers are beginning to wonder if this "blown up" price structure is really safe. With regard to lead, there are special circumstances, for this is a metal of which the consumption during the war fell below the preceding years. In consequence mining operations were reduced, labour was drafted into other fields of enterprise, especially copper mining, and it is going to take some time to get things right again. In the meantime, the demand for lead is large, for industry is struggling to recover its former activities. But things are rather different in copper. Here the trouble has arisen through (*a*) the voluntary reduction of output by mining companies, and (*b*) a series of prolonged and disastrous strikes, as a result of which an enormous tonnage has been lost. True, the trouble in the United States seems to be over, but at the time of writing there is a strike in Rhodesia, and there is no saying where it may break out next. All this is doubtless a symptom common to the aftermath of war, but that does not make things any more pleasant.

Careful consideration of the present situation leads to the conclusion that in the near future there is little likelihood of a downward reaction. This, however, is not much consolation to fabricators, who are selling a long way forward—as much as 12 months, it is believed. What will the position be in a year's time? On the face of it there is every reason to believe that metals are in short supply, but in view of the length

(*Continued overleaf.*)

FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION

Mr. D. Cherry Paterson, M.I.Mech.E., presided over the annual general meeting of the Foundry Trades' Equipment and Supplies Association, held at the Waldorf Hotel, London, recently. Twenty-two members were present. In dealing with financial matters, the president referred to the heavy cost which had been incurred through the operation of the Dextrine Control, which, as from March, 1946, had been taken over by the Government. The income of the association had risen by nearly £100, but the budget indicated that a levy would be required to cover this year's expenses. This was carried unanimously.

Reference was made to the loss the Association had sustained through the death of Mr. H. Winterton, a past-president, and one of its founder members.

The only change in the Council was the election of Mr. W. Aske, of Hull, to fill the vacancy caused by the death of Mr. Winterton. During the course of the year the association had enrolled 10 new members.

It was announced that the Ministry of Labour would not release key men from the forces under Class B, as is the case with the ironfounders, for the equipment industry.

Consideration was given to the forthcoming conference for the reduction of trade barriers, and the Export Group, being more closely identified with the question, are to make recommendations. Mr. Cherry Paterson was very cordially thanked by the meeting for the energy he had displayed during his year of office.

Are Metal Prices Dangerous ?

and strength of the bull movement it is certain that consumers have achieved a big volume of cover on the way up, and that producers are inclined to hold metal back for even better prices. Would anyone be prepared to affirm that copper, for example, will not climb as far as 18 cents? When the top is finally reached, and after a lull, there comes a modest cut in the price from the first seller to take alarm, what will happen? Inevitably a sudden freezing of buying activity, almost a "standstill strike" by consumers, who, with months of cover ahead of them, and large stocks, feel well able to watch events for a long time to come. Then, unless history does *not* repeat itself, unsuspected supplies of metal will be forthcoming, and the rout will begin. In the debacle that follows, the British Government, as one of the world's largest buyers, is likely to be heavily involved, for it is hardly likely that United Kingdom consumers will prove willing buyers in the face of the ebbing price tide. Thoughtful observers of the present situation are arriving more and more at the conclusion, that in spite of many difficulties in the way of re-establishing the futures market in London, this course is the only one which can save the non-ferrous industry from a period of chaos. The need is urgent, and every effort should be made to restore the equalising facilities provided by the Metal Exchange by the end of this year.

EFFECTS OF SHORTAGE OF LINSEED OILS

AUTOMOBILE IRONFOUNDERS' ASSOCIATION'S REPORT

Linseed oil is one of the essential binding materials used by the automobile and allied high-duty section of the ironfounding industry. It is employed, usually in conjunction with other binders, to bond the special type of sand needed for the cores and, in some cases, the actual moulds from which the castings are produced. These cores, or mould sections, are formed with such moulding material in the plastic state and afterwards dried and hardened by baking in stoves. With these intricate types of castings it is essential that the bond should break down to accommodate contraction of the metal on cooling and the removal of the core sand at the fettling stage in which the peculiar properties of linseed oil play an important part.

To base the proposed cuts in the supply of linseed oil on the consumption for the first six months of this year does not give a fair basis, since firms suffered a considerable reduction in output following the fall of Germany, when there was a period of transition to civilian production. The output achieved in that period, therefore, falls substantially below the normal demand or the increasing demand for which the industry is now planning.

Contribution to Export Trade

Considerable stress should be laid on the importance of the contribution which this section of the industry is at present making to the export trade, being engaged on automobile and high-duty iron castings, which are usually more intricately cored than the castings used in other sections of the industry.

Producers in this section all have their products under satisfactory technical control, in fact the section is one of the most highly technically controlled in the industry. It must, therefore, be assumed that the proportion of linseed oil used has already been reduced to the absolute minimum commercially practicable.

Use is being already made of all known direct substitutes for linseed oil (including petroleum extracts) to the maximum extent. This has already been necessitated by war conditions, and has been continually developed in the light of current research. Other usable bonding materials, such as cereals, clays, resins, molasses, sulphide lye, etc., are commonly employed in conjunction with linseed oil and linseed oil substitutes to the fullest practicable extent that the class of work permits.

Reduction in Output

With this intricate class of work it must be accepted that any reduction of linseed oil must result in a *pro rata* reduction of the output from the foundries concerned. The value of the merchandise that will be affected may be many-fold, the reduction affecting the foundry industry caused by the reduction of linseed oil supplies.

It becomes apparent then that the output of castings for the automobile and other trades using cored castings must be in direct proportion to the amount of linseed oil allocated. This in turn will necessarily limit the output of finished products for export, such as motor-cars, transport vehicles, tractors, refrigerators, compressors, machine tools, electrical and other engineering products. The supply of castings for the re-housing of the country, and for tractors essential for food production, would also be affected in the same way, and it should be emphasised that motor-cars or other finished products may be complete except for one cored casting. Since the supply of castings to users is already practically on a day-to-day basis owing to an almost complete absence of stocks, this effect will be felt almost immediately in all the trades affected.

It is most important that this section of the industry should be made aware at the earliest possible moment of the result of these representations, as any continuance of the limitation of supplies of linseed oils will have most serious and early repercussions on a wide range of important industries. It is pointed out that the mere maintenance of the present rate of supplies in itself means a failure to achieve the recovery to normal, and much less the projected programmes of the industries referred to.

[We dealt editorially with this subject in our last issue.—EDITOR.]

NEW CATALOGUES

Pressure Recording and Indicating Meters. A leaflet just issued by the Metronic Instrument Company, Limited, 196, Grove Lane, Smethwick, 40, Staffs, covers, in a general way, such items as circular dial and cabinet indicators; a ring balance for differential pressure measurement, and a few details about floating bells, spring bells, mercury floats, bourdon tubes, transmission, quadrant and pinion, and magnetic transmission. In short, some explanation is given of a line of instruments which foundrymen use for control purposes, and helps them in their choice of make.

Foundry Practice, the house organ of Foundry Services, Limited, Long Acre, Nechells, Birmingham, 7, in their May-June issue, continue articles designed to explain microstructures, and to improve ironfoundry practice. Thereafter, there is a short article which suggests that an emergency cylindrical core can be made by winding asbestos paper on to a steel tube and fastening by means of either fine wire or a daub of core gum. The issue is completed with articles on copper castings, and blind risers. The last article should have indicated that some of the methods described are Patented.

Gunmetals. In Specification Sheet No. 7, the Eyre Smelting Company, Limited, of Tandem Works, Merton Abbey, London, S.W.19, detail the properties of Esco gunmetal (85/5/5/5). Included are the tolerances in composition, the mechanical tests under diverse conditions, furnace atmosphere, fluxes, recommended casting temperatures, rate of cooling, and a note on the interpretation of fractures. It is a very useful addition to the series which the firm issue, dealing with non-ferrous subjects.

PUBLICATIONS RECEIVED

Safety Electrical Equipment and Its Use (Second Edition), by S. W. Richards, M.I.Min.E. Published by the General Electric Company, Limited, Magnet House, Kingsway, London, W.C.2.

This pamphlet describes, not merely the constructional details of almost every kind of flameproof and intrinsically safe electrical apparatus, it also explains in some detail the need for the stringent electro-mechanical precautions taken in the manufacture and installation of such equipment. The pamphlet is now published in a revised form, and includes new descriptive matter on the use of fluorescent lighting in mines and other inflammable situations, on the design of G.E.C. flameproof tubular, and immersion heaters, and on the design of a new flameproof conduit joint. There are also additional notes on the characteristics of inflammable gases and liquids. In this connection, a table is included which shows, at a glance, the flash-points, ignition temperatures, and the explosive limits of the many solvents and gases now used in industry. The book is gratis to those who are interested.

The Stantonian (Vol. 15, No. 12, June, 1946). Published by the Stanton Ironworks Company, Limited, nr. Nottingham. Price 1d.

The house organ of Stanton Ironworks is a particularly evenly balanced magazine, as it contains a well blended mixture of simple technology, and gossip about the company's past and present staff and their activities. Whilst designed to interest a wide range of employees, it maintains a dignity which is sometimes lacking in this type of publication. We congratulate the editor on the presentation of the matter available to him.

CONSTRUCTING PATTERNS TO FAVOUR MOULDING

By "CHIP"

For many jobs there is a variety of ways by which they may be moulded. The choice of method adopted often depends upon the custom of the shop and the equipment available. In these cases the advice of the moulder is often sought before the pattern is started. Other jobs, however, appear to the pattern-maker to be straightforward and allow of only one way for constructing the pattern. On occasions, even these jobs may, by a slight modification to the pattern, be either moulded quicker, or a sounder casting produced, whilst sometimes both advantages may accrue.

A particular example is shown in Fig. 1, which is a bucket for a dipper wheel that was required periodically in batches of 30 or so. The pattern-maker supplied a shell pattern of aluminium, intending the moulder to place it face A on a turnover board and ram the bottom, then turnover and ram the tops and lift the pod forming the interior with this top. Difficulty was often encountered getting a good, clean lift and also to avoid scabbing.

A better method of production consisted of modifying the pattern slightly, by making a portion of the top loose, as in Fig. 2, and placing the pattern on a bottom box, which had been previously rammed, with the face A down, and then ram the interior through the

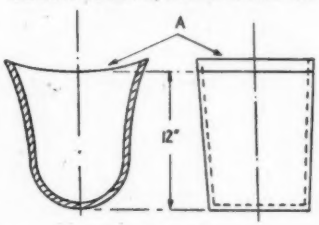


Fig. 1

Fig. 2

opening on top. In this way a more even consistency of ramming was assured and the pattern was lifted off the pod, instead of *vice versa*.

Casting this way up, and pouring through a wedge runner on top, resulted in far more satisfactory castings.

IMPORTS AND EXPORTS OF IRON AND STEEL

BOARD OF TRADE RETURNS FOR JUNE

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in June and in the first six months of 1946. Figures for one-half of 1938 are given for purposes of comparison.

Total Exports of Iron and Steel

Destination.	June, 1946.	Six months ended June.	One-half of 1938.
	Tons.	Tons.	Tons.
Eire	4,690	36,151	27,860
Channel Islands	514	2,903	3,708
Palestine	8,449	46,972	4,036
British West Africa	2,229	22,615	24,872
Union of South Africa	17,199	121,057	115,544
Northern Rhodesia	245	1,866	10,288
Southern Rhodesia	5,598	34,091	18,106
British East Africa	1,221	11,539	12,966
British India	3,875	40,003	79,340
Burma	958	7,436	9,256
British Malaya	5,440	17,453	33,292
Ceylon	1,667	6,312	13,016
Hong Kong	2,778	9,532	11,798
Australia	3,420	17,369	85,452
New Zealand	4,503	24,959	65,942
Canada	1,026	3,747	42,704
British West India Islands	2,586	11,725	22,126
Anglo-Egyptian Sudan	197	7,683	4,146
Other British Countries	1,838	13,802	10,970
Soviet Union	—	2	2,174
Finland	3,800	21,826	8,804
Norway	6,956	44,006	10,136
Iceland	1,348	6,674	330
Denmark	18,700	114,965	43,628
Poland	2,261	12,856	1,244
Netherlands	10,745	97,113	25,780
Dutch East Indies	1,884	2,489	13,654
Dutch West India Islands	801	5,227	1,232
Belgium	1,265	17,736	10,162
France	2,789	42,350	6,694
Portugal	5,863	27,878	3,856
Portuguese East Africa	263	2,194	7,110
Spain	1,618	6,498	3,882
Italy	506	744	2,570
Greece	1,447	5,074	876
Turkey	334	6,934	6,878
Egypt	9,939	60,430	17,204
Iraq	2,853	29,897	12,870
Iran	5,606	51,204	55,190
China	6,054	8,930	11,066
U.S.A.	121	436	1,094
Venezuela	5,645	16,858	2,338
Ecuador	686	1,833	796
Chile	851	3,216	3,116
Brazil	4,271	25,651	8,496
Uruguay	433	3,702	3,794
Argentine	8,704	39,360	39,678
Other Foreign Countries	20,738	119,721	57,858
Total	194.914	1,213,019	957,938

AS A PEACETIME MEASURE to prevent unemployment, the Royal Naval dockyards are being made available for making articles for civilian use. It is emphasised that work to be undertaken is intended to relieve congestion, and not to establish commercial competition.

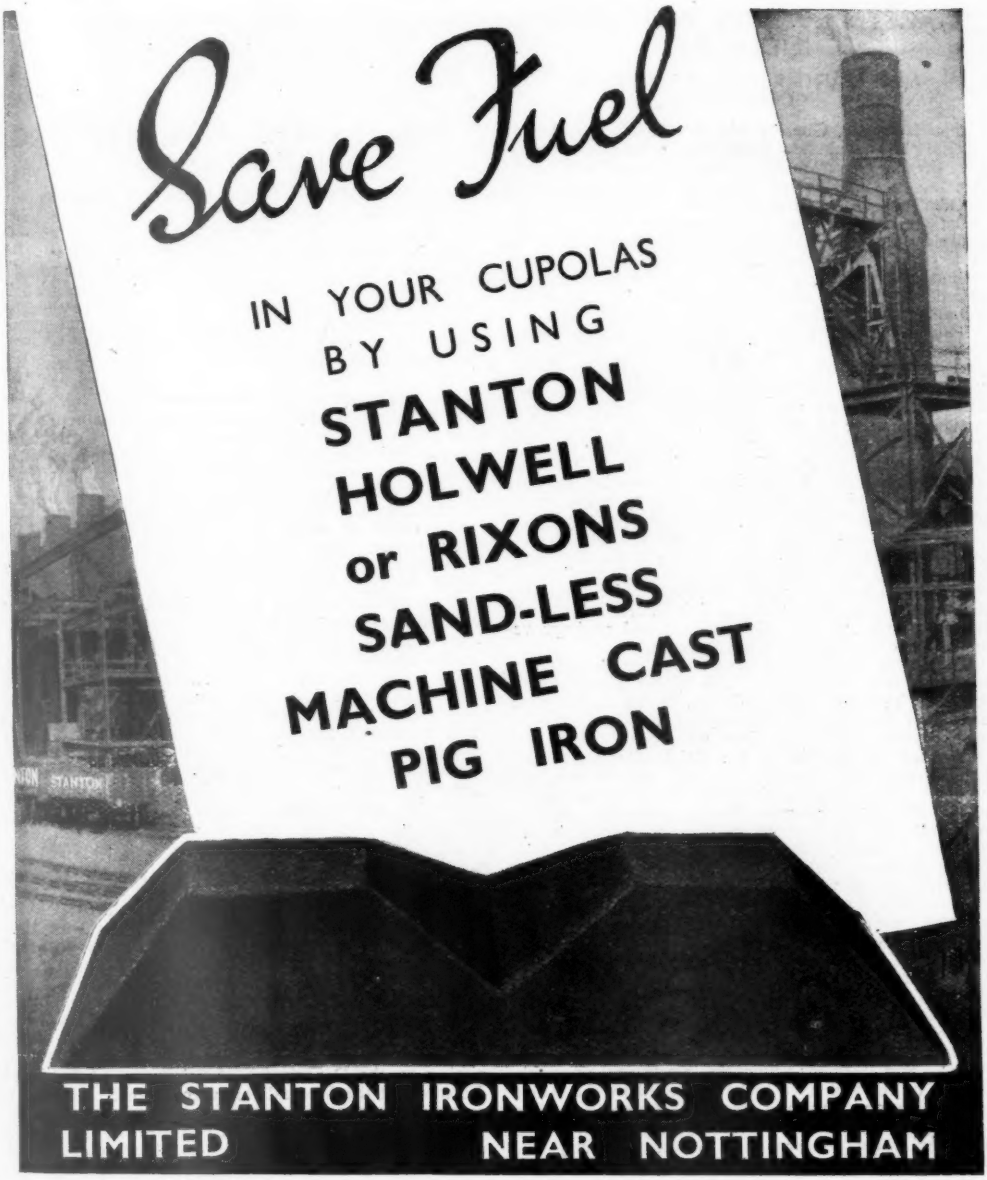
Total Imports of Iron and Steel.

From	June, 1946.	Six months ended June.	One-half of 1938.
	Tons.	Tons.	Tons.
British India	1,501	10,977	77,816
Australia	16,524	47,922	18
Canada	10,120	74,872	58,688
Other British Countries	19	147	2,800
Sweden	239	1,251	44,898
Norway	1,760	3,881	16,888
Belgium	27	2,092	136,840
Luxemburg	15	15	29,300
France	15	75	128,674
U.S.A.	17,104	85,143	100,346
Other Foreign Countries	5	444	75,880
Total	47,329	226,819	672,135
Iron ore and concentrates—			
Manganiferous	10,400	56,200	31,142
Other sorts	565,402	3,059,748	2,550,936
Iron and steel, scrap and waste, fit only for the recovery of metal	30,990	242,023	316,102

Exports of Iron and Steel by Products

Product.	June, 1946.	Six months ended June.	One-half of 1938.
	Tons.	Tons.	Tons.
Pig-iron	1,113	3,262	46,970
Ferro-alloys, etc.—			
Ferro-tungsten	5	204	258
Spiegeleisen and ferro-manganese	1,510	31,905	2,598
All other descriptions*	66	560	524
Ingots, blooms, billets and slabs	576	1,533	4,872
Iron bars and rods	451	6,368	1,598
Sheet and tinplate bars	—	221	6,190
Wire rods and bright steel bars	5,352	27,657	4,884
Other steel bars and rods	21,747	138,895	51,006
Special steel	1,434	8,563	2,466
Angles, shapes and sections	11,218	78,621	33,702
Castings and forgings	277	1,519	810
Girders, beams, joists and pillars	2,822	42,239	16,736
Hoop and strip	6,836	41,830	18,688
Plates, ¼ in. thick and over	26,768	174,029	65,484
Black plates	4,039	14,990	7,270
Black sheets	7,766	21,395	31,756
Galvanised sheets	5,180	14,509	73,468
Tinplates	11,876	54,393	159,660
Tinned sheets	211	1,301	706
Terneplates	59	346	2,162
Decorated tinplates	8	403	2,184
Cast-iron pipes, up to 6-in. dia.	4,362	20,921	24,464
Do., over 6-in. dia.	3,133	15,353	21,482
Wrought-iron tubes	18,864	135,238	109,986
Steel rails	13,540	98,380	53,000
Sleepers and fishplates	4,952	59,542	12,692
Other railway material	1,752	11,064	13,386
Wire	7,443	39,374	27,592
Wire manufactures	3,336	15,909	14,744
Nails, tacks, etc.	563	3,975	1,904
Rivets and washers	962	4,424	4,268
Wood screws	416	2,889	1,256
Bolts, nuts, and metal screws	2,124	11,781	8,786
Stoves, grates, etc.	447	2,920	4,576
Sanitary cisterns	129	504	1,406
Fencing material	510	2,103	2,566
Anchors, etc.	429	2,525	3,168
Chains	682	4,193	3,146
Springs	301	3,422	1,966
Hollow-ware	8,382	36,141	5,352
All other manufactures	13,273	77,618	108,230
Total	194,914	1,213,019	957,938

* The figures for 1946 are not completely comparable with those for earlier years.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AUSTRIAN IRON AND STEEL INDUSTRY

LINZ PLANTS RESTORED TO VIENNA GOVERNMENT

The Hermann Goering plants at Linz, now known as the "Amalgamated Steelworks," were restored to the Vienna Government by the American authorities last month. During the war, these works produced a million tons of steel ingots a year. At a ceremony to mark the handing over of the concern, General Clark, commanding the American occupation forces in Austria, expressed the hope that this measure would extend the economic horizons of the country, and added: "We hope that our allies will take a similar initiative in the other zones."

This development, welcomed by the Austrian Press, has provoked a leader in the "Oesterreichische Zeitung," the official organ of the Red Army in Vienna. "In fact," states the journal, "the gesture thus made by the Americans was long ago anticipated by a similar initiative in the Soviet zone. For here, apart from the few plants working directly for the Red Army, the foundries, whether Austrian or German, were confided to the Austrian administration as early as the autumn of 1945. Even those which were undeniably German property, in the Soviet zone, were placed more than a year ago under administrators nominated by the Austrian Government, and they have worked since then for Austria. A transfer of these establishments to Soviet hands merely signifies the nomination of Soviet administrators, which will result in both an increase in output and an improvement in the conditions of the workers."

The same journal, however, announces that the foundries and steelworks of the Alpine Montangesellschaft at Traisen (Lower Austria), in the Soviet zone, have now become the property of the Soviet Union in execution of the Potsdam agreement. After the annexation of Austria by the Reich, German capital immediately took possession of this undertaking, and invested very considerable sums in transforming the works into an armament plant. After the war, it remained inactive for more than a year. At the moment, it employs about 670 workers.

A preliminary list has been issued of 25 Austrian concerns scheduled by the Government for nationalisation. The list includes the collieries and steelworks of the Alpine Montangesellschaft, the Trauntaler Kohlenbergwerke A.G., the Steirische Kohlenbergwerk A.G., the Vereinigte Stahl- und Eisenwerke at Linz (formerly the Hermann Goering-Werke), the Berndorfer Metallwarenfabrik, the Mannesmann-Röhrenwerke, the Vereinigte Wiener Metallwaren A.G., the Simmering wagon works, the Vienna locomotive works, the Böhler concern in Kapfenberg, and the A.E.G. and Siemens-Schuckert electricity undertakings. The list will have to be approved by the Allied Control Commission, and this is expected to lead to considerable difficulties, since the Russians hold that many of these concerns are German property and therefore liable to confiscation as reparations. Those situated in the Russian zone, it is claimed, have, in fact, already become Russian property under the recent decree expropriating German property.

MEETING DEMAND FOR HOUSING COMPONENTS

Good progress in their plans for restoring and increasing their capacity to manufacture the goods required for the housing programme was reported by Mr. J. Shaw, chairman and managing director of Allied Ironfounders, Limited, at the annual meeting of the company. Plant had been reinstated, labour force re-organised, requisitioned works re-occupied and re-equipped, with the result that they had not been too seriously affected by the unavoidable check to their operations during the transition period, he said, adding that there was still much to be done. Their manufacturing programme was influenced, indeed dictated, by the national requirements, and for a considerable time ahead the bulk of their output would be appropriated for housing schemes. Production was steadily increasing, and every effort was being made to keep ahead of the rate of building.

The foundry industry had been subjected to much unjustifiable criticism, and they did not accept the view either that it did not or could not offer an attractive field of employment. Their plans to make good the lag of the war years covered improvements and extensions not only to their foundries, but to other departments engaged on such processes as vitreous enamelling, which extended the interests of the company beyond the production of ordinary castings. They also included provision for production by materials other than cast iron. Mr. Shaw said he mentioned that because not only had they to meet and encourage the growing demand for more highly finished cast-iron products, but they must retain their interest in the supply of building components should these be preferred in materials other than those the name of their company implied.

FOSTERING ECONOMIC RESEARCH WORK

The report of the Committee on the Provision for Social and Economic Research, which has been published as a White Paper, states that progress in social and economic research has been seriously hampered by lack of money, and that the chief need of the social sciences now is the strengthening of staff and provision for routine research. For various reasons, the Committee is opposed at this stage to the establishment of an official social science research department or council similar to the Department of Scientific and Industrial Research or the Medical Research Council. Instead, it recommends that a standing inter-departmental economic and social research committee be set up to survey and advise on research work in Government departments.

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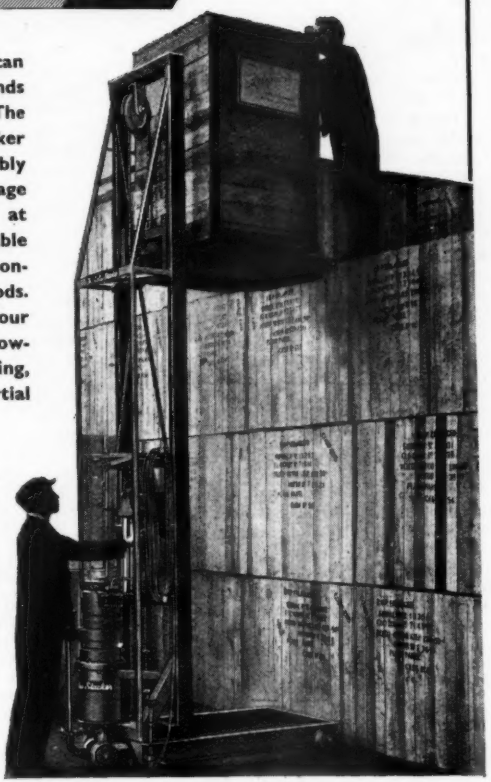

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PERSONAL

THE HON. C. M. MCLAREN has been elected to the board of Thos. Firth & John Brown (Overseas), Limited.

MR. M. LINDSAY and MR. B. R. NICHOLSON have been appointed directors of Gaskell & Chambers, Limited, engineers, brassfounders, etc., of Birmingham.

SIR PAUL M. BOOTH, chairman of Booth & Brookes, Limited, Mildmay Ironworks, Burnham-on-Crouch, has been appointed a Deputy Lieutenant for the County of Essex.

MR. HENRY MAIN, managing director of the Caledon Shipbuilding & Engineering Company, Limited, has been appointed a member of the Catering Wages Commission.

SIR JAMES LITHGOW, Bt., has found it necessary to curtail some of his duties, and has resigned from the boards of Colvilles, Limited, and the Steel Company of Scotland, Limited.

MR. F. H. FARRER has been appointed chairman, as well as managing director, of the Villiers Engineering Company, Limited, Wolverhampton, owing to the death of the late chairman, Sir Charles Marston.

CAPT. H. J. KENNARD, R.N. (Ret.), who has retired from active participation in the affairs of the Falkirk Iron Company, Limited, has been presented with a portable wireless set on behalf of the employees.

SIR WILLIAM GRIFFITHS, chairman and managing director of the Mond Nickel Company, Limited, has been nominated as a representative of that organisation to the Council of the Copper Development Association.

DR. EDWIN GREGORY, chief metallurgist, and BRIG. A. LEVESLEY, general manager of the steelfoundry and ancillary departments, of Edgar Allen & Company, Limited, Imperial Steel Works, Sheffield, have been appointed to the board.

MR. M. F. MORGAN, of the Arthur G. McKee Company, Cleveland, Ohio, arrived in this country recently. Mr. Morgan, who is a specialist in beneficiation and the use of iron ores, will visit Head, Wrightson & Company, Limited, and several of the leading British iron and steel makers.

MR. HUGH WARREN, managing director of the British Thomson-Houston Company, Limited, and formerly director of the company's research and engineering, has received the degree of Doctor of Science, *honoris causa*, at Birmingham University. He is the author of numerous technical books and Papers.

MR. H. ALWYN LENOX has been elected a director of the London branch of Brown, Lenox & Company, Limited, mechanical and constructional engineers, etc. He is a great-great grandson of the late Samuel Lenox, who, in conjunction with Capt. Sir Samuel Brown, R.N., founded the firm in 1806, and is the fifth generation of the family to take an active part in the management of the business.

SIR PERCY H. MILLS, managing director of W. & T. Avery, Limited, and a member of the boards of several other companies, is being released by the Government, at his own request, from his appointment as president of the Economic Sub-commission in the Control Commission for Germany as from the end of August, so that he can return to industry. SIR CECIL M. WEIR has been appointed to succeed Sir Percy.

MR. E. L. DIAMOND has been appointed mechanical engineer to the Plant Engineering Division of the British Iron and Steel Research Association. Mr. Diamond graduated in engineering with honours at King's College, London, in 1922, and then became a pupil of the late Sir Henry Fowler at the Derby locomotive works of the Midland Railway, later assisting in experimental work. Since 1926 he has been on the technical staff of the Institution of Mechanical Engineers, except during the war years 1940-45, when he became Inspector (Components) in the Inspectorate of Fighting Vehicles. He has published a number of Papers on technical locomotive problems, and received the degree of M.Sc. (Eng.) in 1936 for some of this work.

SIR ALEXANDER DUNBAR, whose retirement from the board of the English Steel Corporation, Limited, and Vickers-Armstrongs, Limited, was announced in our last issue, has relinquished his position as chairman and a director of Firth-Vickers Stainless Steels, Limited, as from July 31. MR. C. E. HOLMSTROM, the deputy managing director, is appointed managing director with effect from September 30, when MR. JAMES WORTLEY FAWCETT retires from that position and from the board. MR. J. T. W. DEWAR, formerly general manager of the engineers' tool department, is appointed a director from August 1. He will take up duties as director in charge of production and deputy managing director. MR. J. V. HALL and MR. R. STATON have been appointed special directors of the company.

GOVERNMENT'S PROPOSALS FOR STEEL CRITICISED INDUSTRY

The view that the Government's decision in respect of the iron and steel industry if implemented, might produce a national disaster was put forward by Mr. W. H. Higginbotham when he presided at the annual meeting of Edgar Allen & Company, Limited.

"In May last," he said, "the Prime Minister announced, with truly statesmanlike clarity, his Government's intention to introduce at an early date 'a substantial measure of public ownership' of the iron and steel industry. Subsequent debates and public speeches have done nothing to indicate with any exactitude what is intended; the report of the British Iron and Steel Federation, on behalf of the industry, with its plan for modernisation at a cost of £168,000,000, has not produced any alternative plan, except that the Minister of Supply with Parliamentary authority is forming a Board to control the industry, and to advise as to how nationalisation is to be carried out. In the meantime, a state of extreme uncertainty exists, plans for the future are held up, and development retarded."

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NEWS IN BRIEF

IMPERIAL CHEMICAL INDUSTRIES, LIMITED, have taken 2, Grosvenor Place, London, W., on a long lease for use as offices.

CARDIFF PUBLIC LIBRARIES have assembled as a four-page leaflet all the reports on metallurgical industries in Germany which are available in their buildings for reference purposes.

THE NATIONAL ARBITRATION TRIBUNAL has rejected a wages and hours claim from patternmakers employed by Wishart & Macintyre (Patternmakers), Limited, St. James's Road, Glasgow.

TUBE INVESTMENTS, LIMITED, announce that in order to meet home and export demands for traffic signs their subsidiary company, Gowshall, Limited, of Walsall, will shortly be moved to new premises at Oldbury.

A PROPOSAL IS UNDER CONSIDERATION to preserve as an "ancient monument" a furnace built at Derwent Cote, Ebchester (Co. Durham), in 1710 and used by German sword makers who operated at that time in the district.

A SOUTH AFRICAN NATIONAL PHYSICAL LABORATORY has now been established and is temporarily at the Main Mint, Pretoria. It is under the direction of Dr. S. Meiring Maude, until recently professor of physics at the University of Stellenbosch.

AN ISSUE TO SHAREHOLDERS is to be made by Cozens & Sutcliffe (Holdings), Limited, structural engineers and contractors, of Muswell Hill, London, N.10. It is proposed to offer 71,428 ordinary 4s. shares at 14s. per share to existing holders in the proportion of one new share for every seven held.

THE MONTHLY INFORMATION SHEET of the British Standards Institution for June lists among new standards issued:—B.S. No. 1308: 1946 Reinforced concrete street lighting columns (2s.). New work has been started on zinc rainwater goods. Among draft standards circulated for comment there are CH 5228 Impact test for cast iron, and CH 5607 Sheet steel baths.

IMPORTS INTO THE TYNE for the five months up to the end of May included:—Iron and steel manufactures and scrap, 18,835 tons (14,774 tons in 1945); metals and minerals, excluding iron ore, 12,637 (26,269 tons); iron ore, 131,776 (100,290 tons). In the same period exports from the Tyne included 30,433 tons of iron and steel manufactures, against 10,677 tons last year.

THE FINDINGS OF A Ministry of Labour and National Service inquiry show that the average weekly earnings in January, 1946, of over 5,000,000 workers in the last pay week in January were £4 12s. 7d.—a percentage increase since October, 1938, of 74. The inquiry covered the average earnings and working hours of manual wage-earners in manufacturing industries generally, and in some of the principal non-manufacturing industries. The average hours worked in the last pay week in January, 1946, by all workers, were 45.8, compared with 46.5 in October, 1938.

OBITUARY

MR. PAUL WINN, a director of Paul Winn & Company, Limited, engineers' merchants, of 32, Bishopsgate, London, E.C.2, died recently, aged 83. He founded the company when he was 20 years of age. Mr. Winn was also a director of Winn & Coales, Limited, manufacturers of anti-corrosive pipe wrappings, of Beckenham.

MR. CHARLES B. PUGH has died at the age of 63. He was well known in the Midlands where he had been in business as an iron and steel merchant since 1918 at Walsall. He was also a director of the West Midland Refining Company, Limited. A native of Ulverston, Lancs, Mr. Pugh was trained as a metallurgical chemist at Barrow-in-Furness, but at the age of 17 he went to South Staffs where he joined the firm of Thomas Isaac Bradley, Limited, foundry engineers. He rose to be secretary of this concern. He was for many years secretary of the Staffordshire Iron and Steel Institute and has been an associate member of the Institute of British Foundrymen since 1909.

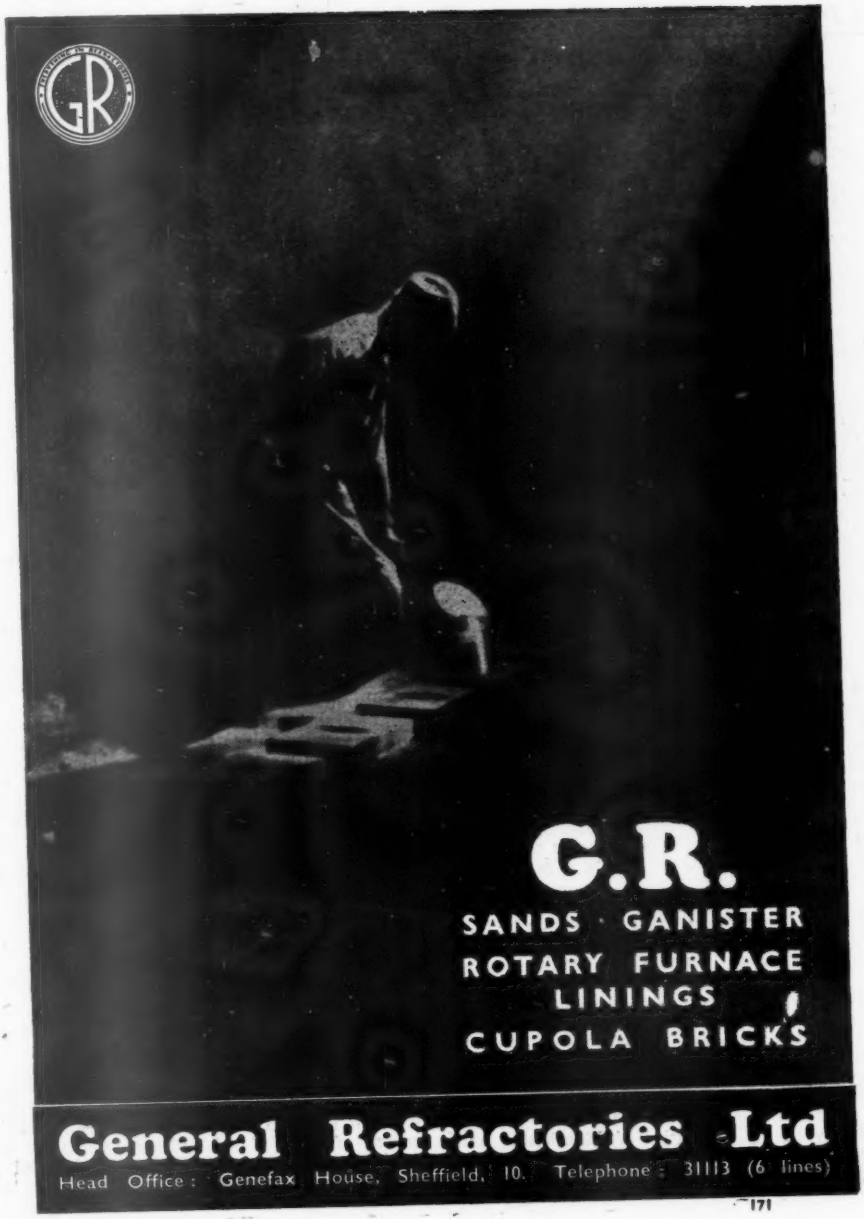
NON-FERROUS SCRAP METAL STOCKS

The Ministry of Supply have issued the following details of Government stocks of non-ferrous scrap metal, as at April 30 last. The stock on charge was 191,668 tons, being made up of:—Q.F. cases and muffled S.A.A., 81,124 tons; ingots, 29,949; lead and lead alloy, 1,430; copper and copper alloy, 19,512; zinc and zinc alloy, 9,886; other grades (including mixed metals from cancelled contracts, Admiralty scrap, M.O.W. scrap and Army scrap), 49,767 tons. Sales for the period April/May amounted to 25,012 tons, of an approximate value of £875,000, and the analysis of this tonnage was as follows:—Q.F. and muffled, 2,825 tons; copper alloy process scrap, 10,385; lead and lead alloy, 7,285; other grades (including zinc and zinc alloy), 4,617 tons. The tonnage of material put out to tender during April/May amounted to 2,600 tons, of which approximately 700 tons were lead. During the period April/May 13,941 tons were invoiced, of a value of £526,070.

CONTROL OF ALUMINIUM

Government wartime control of the purchase of aluminium and light alloys was removed with effect from August 1 under two Orders made by the Ministry of Supply—the Control of Aluminium (No. 7) Order of 1946, and the Light Metals and Alloys Fabrication (No. 2) (Revocation) Order, 1946. As the Ministry has made a contract for the supply of 215,000 metric tons of virgin aluminium from Canada during the years 1946-47, it will continue to be the sole buyer and seller of virgin aluminium.

The Ministry is also cancelling directions previously issued to the light alloy industry requiring the segregation of light alloy scrap into various categories and the making of statistical returns. Arrangements have been made for statistics to be furnished on a voluntary basis by the industry, and totals will be issued monthly by the Ministry of Supply.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Raw Material Markets

IRON AND STEEL

The free issue of licences for the special grades of iron used in the engineering foundries confirms the impression that the gradual acceleration of activity in these establishments is not retarded by any scarcity. But the position in regard to high-phosphorous iron is distinctly tight. It may be true that no serious deficiency in the flow of pig-iron from the blast furnaces to the light-castings foundries has yet been disclosed, but allocations are rigidly controlled. Works are only permitted to acquire sufficient iron for immediate needs and it is manifest that more iron will have to be produced if the output of builders' castings is to keep pace with the housing drive.

The dependence of the re-rolling industry upon external sources of supply for a considerable proportion of their material in the form of billets, bloom and sheet bars is proving an embarrassment under existing conditions. Even during the war period very heavy tonnages of American semis were imported, but these are no longer available, and the Control has been unable to obtain more than very meagre tonnages from the Dominions. Shortages are consequently developing. The sheet mills are rubbing along fairly well, but there is a marked scarcity of billets for the wire and light section mills.

Most of the plate mills have now six months' work in hand. They are refusing export orders and home deliveries are falling into arrears. Improvement in this respect may be anticipated when the holidays are over.

NON-FERROUS METALS

Rather quiet conditions have prevailed this week due to holidays and it is likely to be after the end of this month before industry is in full swing again. There is no indication of any early resumption of trading on the London Metal Exchange. So long as the acute shortage of metal continues it is probable that nothing will be done in this direction. Current prices of non-ferrous metals are considered to be very unsatisfactory, but the weakness of the present position cannot be revealed to the full extent in the absence of trading in futures.

THE CARGO FLEET IRON COMPANY, LIMITED, have received the contract for the structural steelwork for a new factory at Newcastle-upon-Tyne for the Imperial Tobacco Company, Limited.

A MEMORIAL TO Sir Henry Cort Harold Carpenter, F.R.S., D.Sc., in the form of a stained glass window, the gift of Lady Carpenter to St. Mary's Church, Builth Wells, was unveiled by her last week. Sir Harold was one of the original five scientists who formed the nucleus of the staff of the National Physical Laboratory. He became the first Professor of Metallurgy in the University of Manchester, and later served as head of the metallurgical department of the Imperial College of Science and Technology.

GERMAN-OWNED PATENTS

A conference to consider the question of the future treatment of German-owned patents in Allied countries took place in London last month, under the chairmanship of Sir Harold Saunders, the Comptroller of Patents in the United Kingdom. Complete unanimity prevails among the Allied nations that in no circumstances shall any such patents within their territories revert to the former German owners. The question as to how such rights shall in future be disposed of, however, presents many difficulties. A strong sentiment prevails that it would be unfortunate if the continued existence of these patents should constitute an obstacle to international trade.

As a result of the discussions at the conference, the representatives of France, the Netherlands, the United Kingdom and America have signed an accord which will have the effect of making all patents of former German ownership now controlled by their governments, and in which there is no non-German ownership now controlled by their governments, and in which there is no non-German interest existing on August 1, 1946, available within their respective territories to all nationals of the countries party to the accord without payment of royalties or without any requirement to manufacture within the country where the patents exist.

MACHINE TOOLS AS REPARATIONS FROM GERMANY

In the first allotment between the Western Powers of capital plant which is to come as reparations from Germany, Britain has secured equipment from the works of Fritz Mueller, Waldrich, Heniel and Lueg, Jurbelwellenwerk and Hanseatische Kettenwerke—mainly urgently needed machine tools. The procedure for disposing of German reparations plant, of which this is the first minor instalment, will normally follow the lines of the existing disposal schemes for the sale of Government surplus machinery, and the machines will be sold and delivered to buyers' works and will be expected to realise prices roughly equivalent to those ruling in the country for corresponding equipment in the same second-hand condition. It is expected that most of the plant from this batch will go to the steel plant industry.

Davey, Paxman & Company—Profit for the year ended March 31, £61,904 (£59,235); income-tax, £34,000 (£36,000); debenture redemption fund, £1,500 (same); general reserve, £10,000 (same); reserve for post-war contingencies, £5,000 (same); dividend of 15% (same); forward, £11,232 (£8,328).

Associated British Engineering—Net revenue for the year ended March 31, £23,630 (£14,839); dividend of 12% (8%); capital bonus of one ordinary 5s. stock unit of Brush Electrical Engineering Company, Limited, in respect of each £1 of ordinary stock; to dividend equalisation account, £3,000 (£2,000); forward, £8,587 (£5,734).